Geography and Health

Burnside School, Christchurch
June 14th 2016

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Dept of Geography & GeoHealth Laboratory
Mapping of Disease & Health

• Why do we map disease?
Spatial Analysis of Disease & Health

• A long history ...
• **Mapping** and modelling communicable diseases & their diffusion e.g. influenza, HIV/AIDS, ‘cholera’
• Identifying non-communicable disease clusters and their likely causes - focus on:
  – major life style diseases e.g. cancer, heart disease
  – rare diseases e.g. childhood leukaemia, type 1 diabetes
Mapping Disease – A long history

• First case of geography and health: Dr John Snow (‘the father of epidemiology’)

[Broadwick Street sign]

[John Snow's pub]

[Portrait of John Snow]
First Case

- Cholera epidemics in England
  - 1831-32: 22,000 deaths
  - 1848-49: 52,000 deaths
- Confusion about cause (miasmas [bad air] vs germs)
- Enter – *John Snow!*
2. Deaths from cholera in the Soho district of London, September 1854. Dr John Snow’s celebrated map, which established the connection between the cholera outbreak and a single polluted water pump in Broad Street. This emphasized the importance of supplying pure water to the inhabitants of the growing cities of Britain.
Mapped cholera cases & water pumps – suspected Broad St pump as cause
Recommended removal of pump handle & viola, outbreak subsided!
John Snow

• 1854 Epidemic: “Grand Experiment” - Personal survey of cholera victims & what water companies they got their water from
John Snow

• 1854 Epidemic: “Grand Experiment” - Personal survey of cholera victims & what water companies they got their water from
  – Southwark & Vauxhall Water Co (315 deaths per 10,000)
  – Lambeth Water Co (upstream) (37 deaths per 10,000)
    • 8.5 x risk with dirty water

• Raised awareness of environmental risks
  – Led to UK sanitary reform
  – Final UK epidemic 1866: only 2,200 cases
  – Vibrio Cholera, organism that causes cholera was discovered 25 years after Snow died
Cholera Deaths

http://www.worldmapper.org/posters/worldmapper_map232_ver5.pdf
A worldwide epidemic of obesity

Annualized Change in Prevalence of Overweight and Obesity in School-age Children in Survey since 1970 (percentage points)

Causes of obesity

• Genetics
• Individual behaviour: gluttony or sloth
• Obesogenic environments
Obesity Trends* Among U.S. Adults
BRFSS, 1986

(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)
Obesity Trends* Among U.S. Adults
BRFSS, 1988
(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)
Obesity Trends* Among U.S. Adults
BRFSS, 1988
(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)
Obesity Trends* Among U.S. Adults
BRFSS, 1990
(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)
Obesity Trends* Among U.S. Adults
BRFSS, 1992

(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)
Obesity Trends* Among U.S. Adults
BRFSS, 1994
(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)
Obesity Trends* Among U.S. Adults
BRFSS, 1996
(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)
Obesity Trends* Among U.S. Adults
BRFSS, 1998

(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)
Obesity Trends* Among U.S. Adults
BRFSS, 2000

(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)
Obesity Trends* Among U.S. Adults
BRFSS, 2002
(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)
Obesity Trends* Among U.S. Adults
BRFSS, 2004

(*BMI ≥30, or ~30 lbs. overweight for 5’4” person)
Obesity Trends* Among U.S. Adults
BRFSS, 2006
(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)
Obesity Trends* Among U.S. Adults
BRFSS, 2007

(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)
So much more

• Health geography = the application of geographical approaches to the study of health, disease & health care
• Geographic Information Systems (GIS)
Geographic Information Systems (GIS)

What is it?

*a technology that is used to view and analyse data from a geographic perspective*
GIScience

the combination of GIS and associated spatial statistics and spatial thinking applied to the analysis of geographically distributed data
Uses of GIS

- Planning
- Power
- Conservation
- Forestry
- Crime mapping
- Biosecurity
- Sport (tracking athletes)
- Fire, police & ambulance
- History
- Indigenous knowledge
- Community engagement
- Transport
- Waste and stormwater
- Hydrology
- Contaminated land
- Emergency management
- Demography
- Resource management
- Infrastructure
- Health
CERA online maps

The CERA Map

- The CERA Map
- More information about the CERA map viewer

This easy-to-use map viewer will run on any device. It contains the following layers of information:
- Land zone status and technical categories
- Demolition status and section 45 notices
- Prioritised routes for different travel modes from the Accessible City chapter of the Recovery Plan
- Aerial images of the city over time (including aerial pre-September 2010)
- Central City (CCDU) Blueprint and Anchor Projects.

Planning and Community Toolkit (PACT)

A multi-layered desktop tool showing the changes across greater Christchurch providing a raft of information including land use and zoning, transport routes, and population figures to help with future planning in the region.

The aim is to give community groups and organisations easy access to information that will help them plan their own future facilities.

- PACT map viewer
  - More information about Planning and Community Toolkit (PACT)

Christchurch Central: Anchor Projects and Private Sector Prog

This map highlights the Christchurch Central Development Unit (CCDU) Anchor Projects cost sharing split between Crown and Local Government, and features private sector recovery development happening within the area.

Maps and geospatial services

Maps and geospatial services
- Geospatial data - Terms and conditions
- Natural Resource Group GIS network
- Download DOC GeoSpatial Data

DOC Maps

DOC Maps is designed for a broad audience including scientists, planners, Governmental agencies and teachers. It displays information on:
- DOC land, activities and facilities
- general land classifications
- property and cadastral information
- GIS mapping

Annual Report 2013/14

Our latest Annual Report and Annual Report Summary are now available online.
Jobs

Data Analyst
Hudson New Zealand
- Permanent Role
- SQL focus
- CBD Location

Permanent Data Intelligence Analyst, SQL Databases, knowledge of web applications and GIS, CBD location

Information & Communication Technology > Database Development & Administration

Spatial Intelligence Analyst
Hudson New Zealand
- Permanent Role
- CBD Location
- Enterprise GIS environment

Permanent Spatial Intelligence Analyst, GIS, ESRI and Intergraph, enterprise analysis and modelling, some knowledge of SQL a bonus

Information & Communication Technology > Business/Systems Analysts

SPATIAL INTELLIGENCE ANALYST
New Zealand Fire Service

Exciting role within the NZ Fire Service, opportunity to utilise your knowledge within a supportive team and make a real difference to the business!

Information & Communication Technology > Business/Systems Analysts

14/1175 - Senior Geospatial Consultant
Statistics New Zealand
- Christchurch or Wellington - Permanent
- Flexible working hours
- Internal & external training programmes on offer

A key part of this role involves engaging with internal stakeholders to ensure statistical requirements and geospatial solutions are meeting needs.

Government & Defence > Government
Spatial experts added to Immigration's skills shortage list

Immigration New Zealand has responded favourably to an industry request to ease a shortage of geospatial knowledge.

Stephen Bell (Computerworld New Zealand) on 12 February, 2013 20:39

Present, the job spatial scientist (geospatial specialist) appears on Immigration New Zealand’s Long Term Skill Shortage List. This means the Government is actively encouraging skilled geospatial specialists to come to New Zealand to work.
So much more

• Health geography = the application of geographical approaches to the study of health, disease & health care
• Geographic Information Systems (GIS)
  – Determinants of disease and ill health
  – Health care provision
• Visualisation (mapping etc.)
• Spatial analysis
• Disease clustering
• Modelling
• Mobility and Disease Tracking
• 90% of health data has a spatial component
• Patient residence, medical service location, e.g. Census meshblock (MB) or District Health Board (DHB)
• GIS is “a technology that is used to view and analyse data from a geographic perspective”
Mapping


Fig. 3. (a) Child mortality in Auckland, New Zealand (1977–85), expressed as deaths per thousand children per year. (b) Empirical Bayes estimates of child mortality in Auckland.
Visualisation of health data

- **Incidence of Campylobacteriosis in New Zealand 1997-2005**
  - Average incidence: 2,735/100,000
  - Incidence per 100,000:
    - Extremely high (> 3,000)
    - Very high (> 2,600 - 3,000)
    - High (> 1,800 - 2,600)
    - Moderate (> 800 - 1,800)
    - TLA
    - DHB

- **Legionnaires disease rates 15-24 yrs 2003-05**
- **Suicide rates Males 15-24 yrs 2003-05**
- **Melanoma rates 30-39 yrs 1995-04**
- **% smokers 2001**

- **Urban/rural classification**

- **campylobacter rates 1997-06**
Interpretation

• Asking questions
• Inform policy
Death from cholera in the Soho district of London, September 1854. Dr John Snow's celebrated map, which established the connection between the cholera outbreak and a single polluted water pump in Broad Street. This emphasized the importance of supplying pure water to the inhabitants of the growing cities of Britain.
Inequalities in access to and utilisation of health services

- Neighbourhood deprivation & hospital admissions
- Neighbourhood deprivation & GP use
- Travel time and GP use
- Road closure and health access
- Healthline
- Quitline

<table>
<thead>
<tr>
<th>Drive-time scenario</th>
<th>Hospitals</th>
<th>Pop</th>
<th>%</th>
<th>Pop</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>All 24/7 ED Hospitals</td>
<td>25</td>
<td>3,347,940</td>
<td>80.2</td>
<td>3,858,940</td>
<td>92.5</td>
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<tr>
<td>Major Hospitals</td>
<td>13</td>
<td>2,880,390</td>
<td>69.0</td>
<td>3,330,410</td>
<td>79.8</td>
</tr>
</tbody>
</table>
Health care planning and resources
Indices of access/exposure to factors in the built environment

• Creation of exposure indices e.g.
  – Green (parks) and blue (water) space
  – Key resources and destination
  – Social cohesion and isolation
  – Travel time network
  – Urban/rural
  – Earthquakes
Greenspace and health
Investigates the mechanisms by which green space availability may influence mortality outcomes, by contrasting health associations for different types of green space

- Availability of green space linked to positive health outcomes
- Usable or non-usable?
Access to neighbourhood destinations

- Access to ‘unhealthy’
  - Tobacco
  - Alcohol
  - ‘Unhealthy’ food sources
  - Gambling opportunities

- Access to ‘healthy’
  - Green and blue space
    - proximity vs visual
    - Useable vs non-useable
**Food environments around schools**

Fast-food outlets are clustered around low decile secondary schools in densely populated and commercial zoned areas

- Food outlet proximity and exposure and access to unhealthy obesity promoting foods
- **GIS spatial cluster analysis**
Contextual Explanations of Gambling Behaviour

Neighbourhood access to opportunities for gambling is related to gambling and problem gambling behaviour

- Venue location and access patterned by social deprivation

- Location and accessibility

- GIS derived travel distance to the nearest gambling venue
Air quality exposure and health

- Exposure to air pollution
- Environmental justice
- Health impact

Fig. 12. Median UFP concentrations (pt/cm$^3 \times 10^3$) for Mangere Bridge – a) early morning b) midday c) late afternoon and d) late evening.
Residential exposure to visible blue space (but not green space) associated with lower psychological distress in a capital city

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b Michigan State University, Department of Geography, 673 Auditorium Road, East Lansing, MI 48824, USA
c University of Otago, Department of Public Health, 23A Mein Street, Wellington 6242, New Zealand

Fig. 1. Distribution of natural environments throughout Wellington City and the greater region.
Personal tracking

- Tracking people
- Life course
- Spatio-temporal
- The exposome
The Sensing City and Health: COPD pilot project

SEN S I N G
CITY

UC GEOHEALTH LABORATORY
What might be an improvement?

• Lets follow a “hypothetical” individual called Tony...

• How does his COPD condition alter as he moves through the smart city?
Social media maps: twitter and illness maps: the flu

About 18,000 daily mentions of specific symptoms on Twitter and uses location data to plot these on a map of the country, updating it in real time.

http://www.ssp.co.jp/stac/#/japan

Colour = symptoms
The GeoHealth Laboratory?

• A partnership between Health & Disability Intelligence (HDI), MoH, & the Department of Geography, UC

• Seeks to advance MoH policy & UC’s health sciences research agenda for the mutual benefit of the New Zealand health sector

• Aims to:
  – Build a strategic partnership around health geography, spatial epidemiology, & Geographical Information Systems (GIS)
  – Increase research capacity & research outputs in health & GIS
History

• Launched by the Minister of Health, Nov 2004 at the GeoHealth Conference, Wellington
• Formally opened on the 18\textsuperscript{th} February 2005
• Visited by Prime Minister, Helen Clark 6\textsuperscript{th} May 2005
  – "I didn't realise geography was so jazzy!"
Staff and students

- Research staff (postdocs)
- Graduate students
  - Masters and PhD
- UC staff
  - Academics – Geography & other
  - Technical GIS & other support
Graduates

• Kurt Janssen (PHI intern) - MoH, MfE, ESRI, Interpret (Christchurch)
• Katherine Tisch (Masters) – ESR, GeoHealth Lab, Edinburgh Uni
• Erin Holmes (Masters) - MoH (Wellington)
• Kate McPherson (Masters) – Christchurch City Council
• Laura Miller (PhD) – Western Australia Health Department
• Chris Bowie (Masters) – Opus (Wellington)
• Sam Valentine (Masters) - Appian Group (Sydney)
• Matt Willoughby (Masters) - Canterbury District Health Board
• Kimberley Reed (Masters GIS) – Marlborough Lines Ltd
• Dan Nutsford (Masters GIS) – Auckland Council
• Jayden MacRae (Masters) – CEO, Patients First, Wellington
• Nick Brunsdon (Masters) – Canterbury Development Corporation
• Andreas Wilson (Masters) – Christchurch City Council
• Daniel Hogg (PhD) – GIS professional, Germany